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# Development Board EPC9036 Quick Start Guide

Monolithic Half-Bridge with  
Gate Drive for EPC2100

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## DESCRIPTION

These development boards are in a monolithic half-bridge topology with on-board gate drives, featuring the EPC2100 eGaNIC (Enhancement-mode Gallium Nitride Integrated Circuit). The purpose of these development boards is to simplify the evaluation process of these monolithically integrated eGaN FETs by including all the critical components on a single board that can be easily connected into any existing converter.

The development board is 2" x 2" and contains one eGaNIC in half-bridge configuration using the Texas Instruments LM5113 gate driver, supply and bypass capacitors. The board contains all critical components and layout for optimal switching performance and has additional area to add buck output filter components on board. There are also various probe points to facilitate simple waveform measurement and efficiency calculation. A complete block diagram of the circuit is given in Figure 1.

For more information on the EPC2100 eGaNIC, please refer to the datasheet available from EPC at [www.epc-co.com](http://www.epc-co.com). The datasheet should be read in conjunction with this quick start guide.

**Table 1: Performance Summary ( $T_A = 25^\circ\text{C}$ )**

| SYMBOL    | PARAMETER                              | CONDITIONS                          | MIN   | MAX | UNITS |
|-----------|----------------------------------------|-------------------------------------|-------|-----|-------|
| $V_{DD}$  | Gate Drive Input Supply Range          |                                     | 7     | 12  | V     |
| $V_{IN}$  | Bus Input Voltage Range                |                                     |       | 24* | V     |
| $V_{OUT}$ | Switch Node Output Voltage             |                                     |       | 30  | V     |
| $I_{OUT}$ | Switch Node Output Current             |                                     |       | 25* | A     |
| $V_{PWM}$ | PWM Logic Input Voltage Threshold      | Input 'High'                        | 3.5   | 6   | V     |
|           |                                        | Input 'Low'                         | 0     | 1.5 | V     |
|           | Minimum 'High' State Input Pulse Width | $V_{PWM}$ rise and fall time < 10ns | 50    |     | ns    |
|           | Minimum 'Low' State Input Pulse Width  | $V_{PWM}$ rise and fall time < 10ns | 100 # |     | ns    |

\*\*Maximum input voltage depends on inductive loading, Maximum switch node ringing must be kept under 30 V

\*Maximum current depends on die temperature – actual maximum current will be subject to switching frequency, bus voltage and thermal cooling. eGaNIC intended for high step-down ratio applications.

# Limited by time needed to 'refresh' high side bootstrap supply voltage.

### Demonstration Board Notification

EPC9036 boards are intended for product evaluation purposes only and are not intended for commercial use. As evaluation tools, they are not designed for compliance with the European Union directive on electromagnetic compatibility or any other such directives or regulations. As board builds are at times subject to product availability, it is possible that boards may contain components or assembly materials that are not RoHS compliant. Efficient Power Conversion Corporation (EPC) makes no guarantee that the purchased board is 100% RoHS compliant. No Licenses are implied or granted under any patent right or other intellectual property whatsoever. EPC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.

EPC reserves the right at any time, without notice, to change said circuitry and specifications.

QUICK START PROCEDURE

The development boards are easy to set up to evaluate the performance of the eGaNIC. The board allows the on-board placement of buck output filter components. Refer to Figure 2 for proper connect and measurement setup and follow the procedure below:

1. With power off, connect the input power supply bus to +V<sub>IN</sub> (J5, J6) and ground / return to -V<sub>IN</sub> (J7, J8).
2. With power off, connect the switch node of the half bridge OUT (J3, J4) to your circuit as required.
3. With power off, connect the gate drive input to +V<sub>DD</sub> (J1, Pin-1) and ground return to -V<sub>DD</sub> (J1, Pin-2).
4. With power off, connect the input PWM control signal to PWM (J2, Pin-1) and ground return to any of the remaining J2 pins.
5. Turn on the gate drive supply – make sure the supply is between 7 V and 12 V range.
6. Turn on the bus voltage to the required value (do not exceed the absolute maximum voltage on V<sub>OUT</sub> of 30 V).
7. Turn on the controller / PWM input source and probe switching node to see switching operation.
8. Once operational, adjust the bus voltage and load PWM control within the operating range and observe the output switching behavior, efficiency and other parameters.
9. For shutdown, please follow steps in reverse.

NOTE. When measuring the high frequency content switch node (OUT), care must be taken to avoid long ground leads. Measure the switch node (OUT) by placing the oscilloscope probe tip through the large via on the switch node (designed for this purpose) and grounding the probe directly across the GND terminals provided. See Figure 3 for proper scope probe technique.

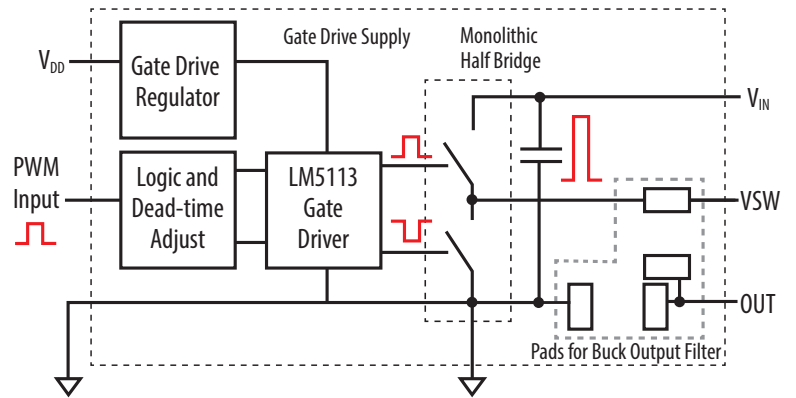


Figure 1: Block Diagram of Development Board

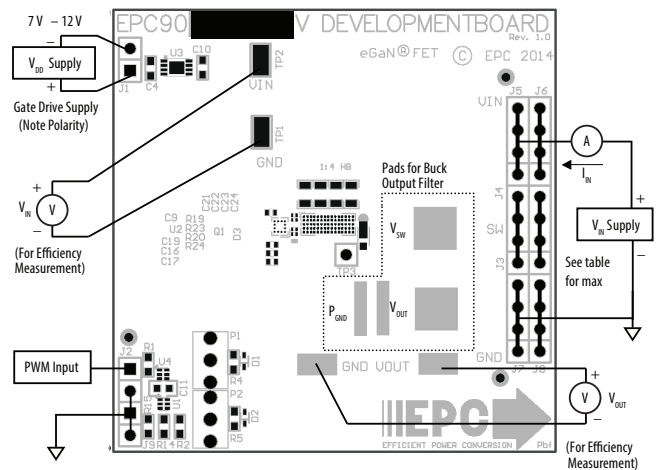


Figure 2: Proper Connection and Measurement Setup

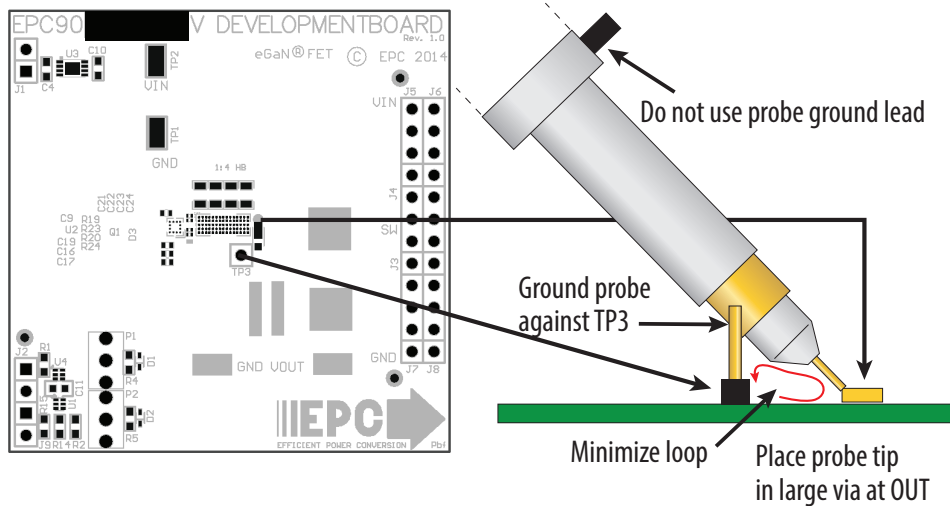


Figure 3: Proper Measurement of Switch Node – OUT

## THERMAL CONSIDERATIONS

The EPC9036 development boards showcase the EPC2100 eGaNIC. These development boards are intended for bench evaluation with low ambient temperature and convection cooling. The addition of heat-sinking and forced air cooling can significantly increase

the current rating of these devices, but care must be taken to not exceed the absolute maximum die temperature of 150°C.

NOTE: The EPC9036 development boards do not have any current or thermal protection on board.

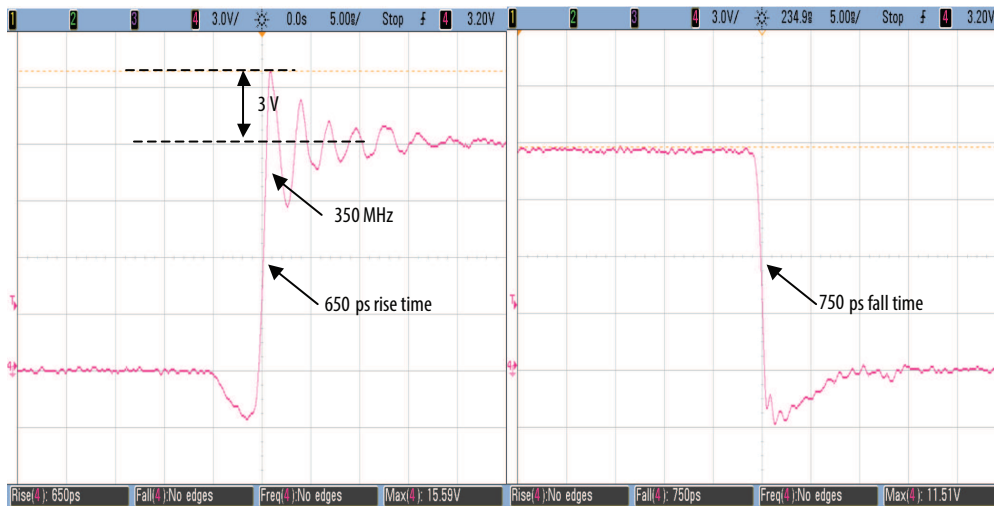
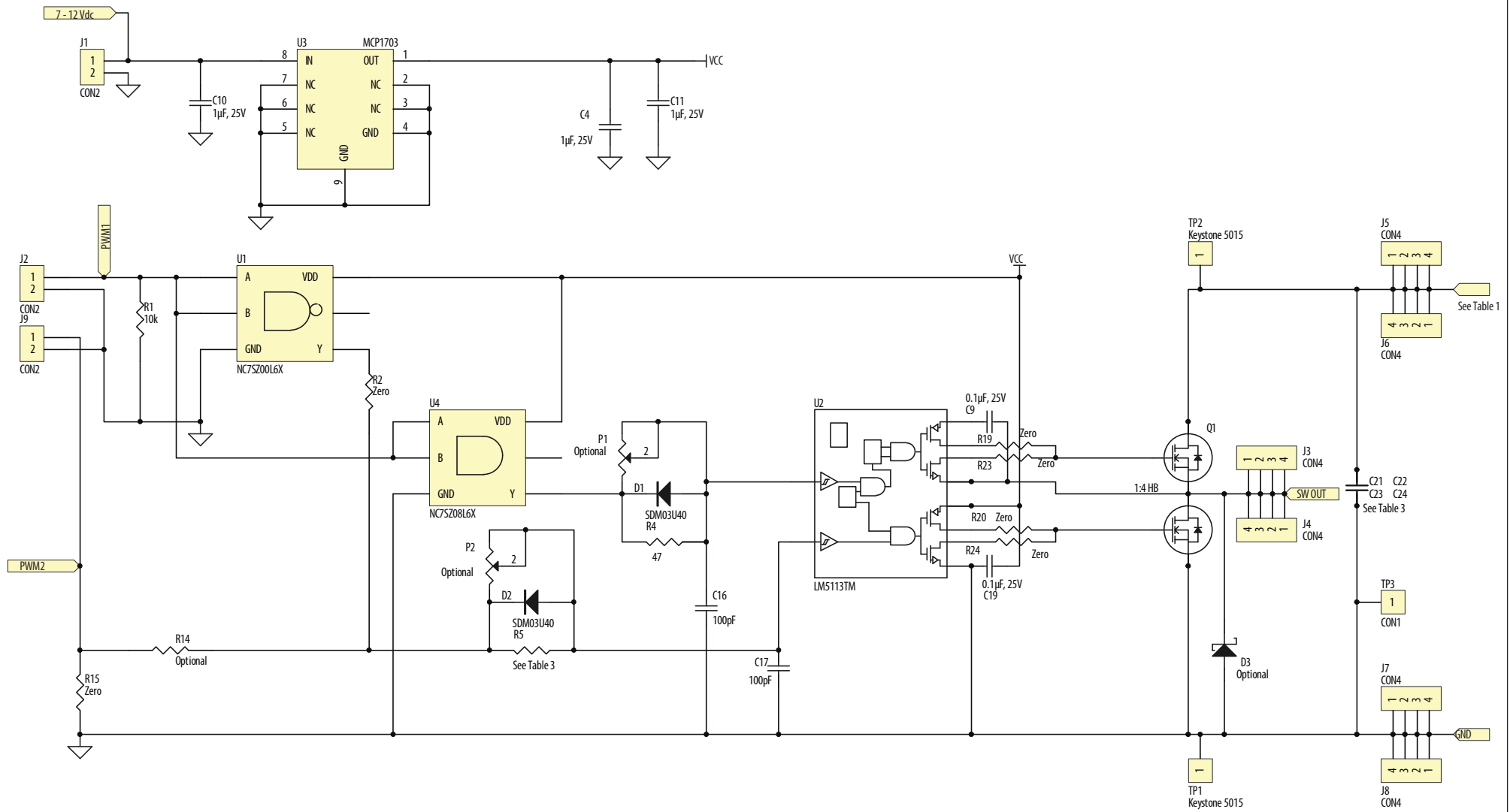


Figure 4: Typical Waveforms for  $V_{in} = 12\text{ V}$  to  $1.2\text{ V}/25\text{ A}$  (1000 kHz) Buck converter showing rising and falling edges, CH4: ( $V_{out}$ ) Switch node voltage

**Table 3: Bill of Materials - Amplifier Board**

| Item | Qty | Reference              | Part Description                       | Manufacturer                 |
|------|-----|------------------------|----------------------------------------|------------------------------|
| 1    | 3   | C4, C10, C11,          | Capacitor, 1 $\mu$ F, 10%, 25 V, X5R   | Murata, GRM188R61E105KA12D   |
| 2    | 2   | C16, C17               | Capacitor, 100pF, 5%, 50 V, NP0        | Kemet, C0402C101K5GACTU      |
| 3    | 2   | C9, C19                | Capacitor, 0.1 $\mu$ F, 10%, 25 V, X5R | TDK, C1005X5R1E104K          |
| 4    | 4   | C21, C22, C23, C24     | Capacitor, 4.7 $\mu$ F, 10%, 50 V, X5R | TDK, C2012X5R1H475K125AB     |
| 5    | 2   | D1, D2                 | Schottky Diode, 30 V                   | Diodes Inc., SDM03U40-7      |
| 6    | 3   | J1, J2, J9             | Connector                              | 2 pins of Tyco, 4-103185-0   |
| 7    | 6   | J3, J4, J5, J6, J7, J8 | Connector                              | FCI, 68602-224HLF            |
| 8    | 1   | Q1                     | eGaNIC                                 | EPC2100                      |
| 9    | 1   | R1                     | Resistor, 10.0K, 5%, 1/8 W             | Stackpole, RMCF0603FT10K0    |
| 10   | 2   | R2, R15                | Resistor, 0 Ohm, 1/8W                  | Stackpole, RMCF0603ZTOR00    |
| 11   | 1   | R4                     | Resistor, 47 Ohm, 1%, 1/8W             | Stackpole, RMCF0603FT47R0    |
| 12   | 1   | R5                     | Resistor, 22 Ohm, 1%, 1/8W             | Stackpole, RMCF0603FT22R0    |
| 13   | 4   | R19, R20, R23, R24     | Resistor, 0 Ohm, 1/20W                 | Panasonic, ERJ-1GE0R00C      |
| 14   | 2   | TP1, TP2               | Test Point                             | Keystone Elect, 5015         |
| 15   | 1   | TP3                    | Connector                              | 1/40th of Tyco, 4-103185-0   |
| 16   | 1   | U1                     | I.C., Logic                            | Fairchild, NC7S200L6X        |
| 17   | 1   | U2                     | I.C., Gate driver                      | Texas Instruments, LM5113    |
| 18   | 1   | U3                     | I.C., Regulator                        | Microchip, MCP1703T-5002E/MC |
| 19   | 1   | U4                     | I.C., Logic                            | Fairchild, NC7S208L6X        |
| 20   | 0   | R14                    | Optional Resistor                      |                              |
| 21   | 0   | D3                     | Optional Diode                         |                              |
| 22   | 0   | P1, P2                 | Optional Potentiometer                 |                              |



**Development Board Schematic  
EPC9036**